

THAT WHICH IS CLAIMED:

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comprising:

1 A method of producing a foamed material, said method
comprising:
5 contacting a mixture comprising a first thermoplastic polymer and a
second thermoplastic polymer with a blowing agent, wherein the first
thermoplastic polymer has a higher percent crystallinity than the second
thermoplastic polymer; and

10 subjecting the mixture to conditions sufficient to create a
thermodynamic instability in the mixture to foam the mixture, the mixture
comprising the first and second thermoplastic polymers having a percent
crystallinity lower than the first thermoplastic polymer.

15 2. The method according to Claim 1, wherein the blowing agent is
carbon dioxide.

3. The method according to Claim 2, wherein the carbon dioxide is
liquid carbon dioxide.

20 4. The method according to Claim 2, wherein the carbon dioxide is
supercritical carbon dioxide.

5. The method according to Claim 1, wherein at least one of the
first and second thermoplastic materials is amorphous.

25 6. The method according to Claim 5, wherein the mixture of
thermoplastic materials is amorphous.

30 7. The method according to Claim 1, wherein at least one of the
first and second thermoplastic materials is semicrystalline.

8. The method according to Claim 1, wherein the first thermoplastic
polymer is semicrystalline and the second thermoplastic material is
amorphous.

9. The method according to Claim 8, wherein the mixture of thermoplastic materials is amorphous.

10 10. The method according to Claim 1, wherein the first and second thermoplastic polymers are each independently selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PVF, PVDC, PVC, PVOH, PVAc, PC, ethyl acetate, PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof.

11. The method according to Claim 1, wherein the first thermoplastic polymer is selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PVF, PVDC, PVOH, PVAc, PC, ethyl acetate, PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof; and the second thermoplastic polymer is selected from the group consisting of PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PC, chemical derivatives thereof, and mixtures thereof.

12. The method according to Claim 1, wherein the first thermoplastic polymer is PVDF and the second thermoplastic polymer is PMMA.

25 13. The method according to Claim 1, wherein said subjecting
step comprises separating the mixture from the blowing agent to foam the
mixture.

14. The method according to Claim 13, wherein said step of
30 separating the mixture comprises venting the blowing agent.

15. The method according to Claim 1, wherein the blowing agent further includes a co-solvent.

16. The method according to Claim 1, wherein the blowing agent further includes a surfactant.

17. The method according to Claim 16, wherein the blowing agent is carbon dioxide and the surfactant comprises a CO₂-philic segment.

18. The method according to Claim 16, wherein the CO₂-philic segment comprises a fluoropolymer.

19. The method according to Claim 17, wherein the CO₂-philic segment comprises a fluoropolymer formed from at least one monomer selected from the group consisting of fluoroacrylate monomers, fluoroolefin monomers, fluorostyrene monomers, fluoroalkylene oxide monomers, fluorinated vinyl alkyl ether monomers, and mixtures thereof.

20. The method according to Claim 17, wherein the surfactant comprises a CO₂-phobic segment.

21. The method according to Claim 20, wherein the CO₂-phobic segment is a polymer formed from at least one monomer selected from the group consisting of styrenics, α -olefins, ethylene oxides, dienes, amides, esters, sulfones, sulfonamides, imides, thiols, alcohols, diols, acids, ethers, ketones, cyanos, amines, quaternary ammonium salts, acrylates, methacrylates, thiozoles, and mixtures thereof.

22. The method according to Claim 16, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer, a block copolymer, and a random copolymer.

23. The method according to Claim 1, wherein the blowing agent further includes a modifier selected from the group consisting of a reactant modifier, water, a plasticizing agent, an anti-bacterial agent, a toughening

agent, a processing aid, a colorant, a dye, a flame retardant, and mixtures thereof.

24. A method of extrusion processing a mixture of thermoplastic materials, said process comprising:

introducing at least two thermoplastic polymers into an extruder barrel, the at least two thermoplastic polymers comprising a first thermoplastic polymer and a second thermoplastic polymer, and wherein the first thermoplastic polymer has a percent higher crystallinity than the second thermoplastic polymer;

heating the mixture of thermoplastic materials to provide a molten blend thereof;

contacting the molten blend of thermoplastic materials with a blowing agent; and

subjecting the blend to conditions sufficient to create a thermodynamic instability in the blend to foam the blend, wherein the foamed blend has a percent crystallinity lower than the first thermoplastic polymer.

25. The method according to Claim 24, wherein said step of contacting the molten blend of thermoplastic materials occurs in a mixing section of the extruder.

26. The method according to Claim 24, wherein said subjecting step comprises separating the blowing agent from the molten blend of thermoplastic polymers to form a foamed thermoplastic mixture.

27. The method according to Claim 26, wherein said step of separating the blowing agent from the blend comprises venting the blowing agent.

28. The method according to Claim 24, wherein the blowing agent is carbon dioxide.

29. The method according to Claim 28, wherein the carbon dioxide is liquid carbon dioxide.

30. The method according to Claim 28, wherein the carbon dioxide
5 is supercritical carbon dioxide.

31. The method according to Claim 24, wherein at least one of the first and second thermoplastic materials is amorphous.

10 32. The method according to Claim 31, wherein the blend of
thermoplastic materials is amorphous.

33. The method according to Claim 24, wherein at least one of the first and second thermoplastic materials is semicrystalline.

34. The method according to Claim 33, wherein the first thermoplastic polymer is semicrystalline and the second thermoplastic material is amorphous.

35. The method according to Claim 24, wherein the first thermoplastic polymer and the second thermoplastic polymer are each independently selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PVF, PVDC, PVOH, PVAc, PC, poly(ethyl acetate), PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof.

36. The method according to Claim 24, wherein the first
30 thermoplastic polymer is selected from the group consisting of PVDF, sPS,
PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PVF, PVDC,
PVOH, PVAc, PC, poly(ethyl acetate), PET, poly(ethylene naphthalate),
poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and

mixtures thereof; and the second thermoplastic polymer is selected from the group consisting of PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PC, chemical derivatives thereof, and mixtures thereof.

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37. The method according to Claim 24, wherein the first thermoplastic polymer is PVDF and the second thermoplastic polymer is PMMA.

10 38. The method according to Claim 24, wherein the blowing agent further includes a co-solvent.

39. The method according to Claim 24, wherein the blowing agent is carbon dioxide and further includes a surfactant.

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40. The method according to Claim 39, wherein the surfactant comprises a CO₂-philic segment.

20 41. The method according to Claim 40, wherein the CO₂-philic segment comprises a fluoropolymer

42. The method according to Claim 40, wherein the CO₂-philic segment comprises a fluoropolymer formed from at least one monomer selected from the group consisting of fluoroacrylate monomers, fluoroolefin monomers, fluorostyrene monomers, fluoroalkylene oxide monomers, fluorinated vinyl alkyl ether monomers, and mixtures thereof.

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43. The method according to Claim 40, wherein the surfactant comprises a CO₂-phobic segment.

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44. The method according to Claim 43, wherein the CO₂-phobic segment is a polymer formed from at least one monomer selected from the group consisting of styrenics, α -olefins, ethylene oxides, dienes, amides, esters, sulfones, sulfonamides, imides, thiols, alcohols, diols, acids, ethers,

ketones, cyanos, amines, quaternary ammonium salts, acrylates, methacrylates, thiozoles, and mixtures thereof.

45. The method according to Claim 39, wherein the surfactant is a copolymer selected from the group consisting of a graft copolymer, a block copolymer, and a random copolymer.

46. The method according to Claim 24, wherein the blowing agent further includes a modifier selected from the group consisting of a reactant modifier, water, a plasticizing agent, an anti-bacterial agent, a toughening agent, a processing aid, a colorant, a dye, a flame retardant, and mixtures thereof.

47. A composition of matter comprising:
a mixture comprising a first thermoplastic polymer and a second thermoplastic polymer, wherein the first thermoplastic polymer has a higher percent crystallinity than the second thermoplastic polymer and wherein the mixture comprising the first and second thermoplastic polymers has a percent crystallinity lower than the first thermoplastic polymer; and
a blowing agent

48. The composition according to Claim 47, wherein said blowing agent is carbon dioxide.

49. The composition according to Claim 48, wherein the carbon dioxide is liquid carbon dioxide.

50. The composition according to Claim 48, wherein the carbon dioxide is supercritical carbon dioxide.

51. The composition according to Claim 47, wherein at least one of the first and second thermoplastic materials is amorphous.

52. The composition according to Claim 51, wherein the blend of thermoplastic materials is amorphous.

53. The composition according to Claim 50, wherein at least one of
5 the first and second thermoplastic materials is semicrystalline.

54. The composition according to Claim 47, wherein the first thermoplastic polymer is semicrystalline and the second thermoplastic material is amorphous.

55. The composition according to Claim 52, wherein the mixture of thermoplastic materials is amorphous.

56. The composition according to Claim 47, wherein the first thermoplastic polymer is selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PVF, PVDC, PVOH, PVAc, PC, poly(ethyl acetate), PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof; and the second thermoplastic polymer is selected from the group consisting of PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PC, chemical derivatives, and mixtures thereof.

57. The composition according to Claim 47, wherein the first thermoplastic polymer and the second thermoplastic polymer are each independently selected from the group consisting of PVDF, sPS, PTFE, PVC, Nylon (6,6), polyvinylmethylether, PP, PE, HDPE, PS, PMMA, polyisobutylene, PVA, PDMS, PEO, poly(phenylene oxide), PVF, PVDC, PVOH, PVAc, PC, ethyl acetate, PET, poly(ethylene naphthalate), poly(ϵ -caprolactone), poly(ether imide), chemical derivatives thereof, and mixtures thereof.

58. The composition according to Claim 47, wherein the first thermoplastic polymer is PVDF and the second thermoplastic polymer is PMMA.

5 59. The composition according to Claim 47, wherein the blowing agent further includes a co-solvent.

60. The composition according to Claim 47, wherein the blowing agent is carbon dioxide and further includes a surfactant.

10 61. The composition according to Claim 60, wherein the surfactant comprises a CO₂-philic segment.

15 62. The composition according to Claim 61, wherein the CO₂-philic segment comprises a fluoropolymer.

63. The composition according to Claim 61, wherein the surfactant comprises a CO₂-phobic segment.

20 64. The composition according to Claim 47, wherein the blowing agent further includes a modifier selected from the group consisting of a reactant modifier, water, a plasticizing agent, an anti-bacterial agent, a toughening agent, a processing aid, a colorant, a dye, a flame retardant, and mixtures thereof.

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